



Flipping Physics Lecture Notes:

Review of Mechanical Energy and Momentum Equations and When To Use Them!

Mechanical Energy Equations:

- Conservation of Mechanical Energy: $ME_i = ME_f$
 - Use when $W_{friction} = 0$ & $W_{F_a} = 0$
- Work due to friction equation: $W_{friction} = \Delta ME$
 - Use when $W_{friction} \neq 0$ & $W_{F_a} = 0$
- Net Work and Kinetic Energy equation: $W_{net} = \Delta KE$
 - This equation is *always true!*
 - Do not confuse with $W_{friction} = \Delta ME$ even though they look so similar.
- Whenever you use these equations you must first identify: Initial Point, Final Point, and Zero Line

The following is from my video "Review of Momentum, Impact Force, and Impulse". flippingphysics.com/impulse-review.html

Conservation of Momentum: $\sum \vec{p}_i = \sum \vec{p}_f$

- Remember to write out the full equation before you use it.
 - $m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} = m_1 \vec{v}_{1f} + m_2 \vec{v}_{2f}$
- Momentum is conserved when all forces are internal.
 - In other words, during all collisions and explosions.
 - An explosion is a collision moving backwards in time.
- A minimum of two objects in this equation!

Force of Impact: $\sum \vec{F} = \frac{\Delta \vec{p}}{\Delta t} = \frac{m\vec{v}_f - m\vec{v}_i}{\Delta t}$

- Clearly we use this equation when we are solving for the force of impact during a collision.
- This equation only deals with the force acting on 1 object!

Impulse: $\sum \vec{F} = \frac{\Delta \vec{p}}{\Delta t} \Rightarrow \text{Impulse} = \Delta \vec{p} = \sum \vec{F}_{avg} \Delta t$

- Impulse is the area under the curve.
- Again, this equation only deals with the impulse acting on 1 object!
- Impulse equals three things: $\Delta \vec{p}$ and $\sum \vec{F}_{avg} \Delta t$ and Area under the Force vs. Time curve.

Three important additions:

1. Students often tell me the work due to friction needs to be zero for Conservation of Momentum to be true. This is not correct and is probably because they confuse Conservation of Momentum with Conservation of Energy. Conservation of Momentum is true when all the forces are internal or balanced. We translate that to mean during all collisions and explosions.
2. You do not need to identify initial and final points because they are always assumed as:
 - a. Initial point is right before the collision/explosion.
 - b. Final point is right after the collision/explosion.
3. Impulse and Impact force both start with the letter "I" and often get confused by students.
 - a. Don't let this happen to you!